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DETECTION OF BRAIN TUMOR IN MRI IMAGES, USING COMBINATION OF BFCM AND ELM

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***Abstract*— The detection of brain tumor is one of the most challenging tasks in the field of medical image processing, since brain images are very complicated and tumors can be analyzed efficiently only by the expert radiologists. Therefore, there is a significant need to automate this process. In this paper, a method for the automatic detection of the tumor from the brain magnetic resonance imaging (MRI) images has been proposed. For this, the region-based segmentation of the input MRI image is done. The wavelet-based decomposition of the input image is done and the input image is reconstructed on the basis of soft thresholding for the enhancement of the image. After that, fuzzy c-means clustering (FCM) followed by seeded region growing is applied to detect and segment the tumor from the brain MRI image and finally comparison using combination with BFCM and ELN.**

MRI is the most important technique, in detecting the brain tumor. In this project data mining methods are used for classification of MRI images. A new hybrid technique based on the support vector machine (SVM) and fuzzy c-means for brain tumor classification is proposed

***Keywords*— FCM, BCFM, ELM**

I. INTRODUCTION

In image processing, images convey the information where input image is processed to get output also an image. In today's world, the images used are in digital format. In recent times, the introduction of information technology and e-healthcare system in medical field helps clinical experts to provide better health care for patients. This study reveals the problem segmentation of abnormal and normal tissues from MRI images using gray-level co-occurrence matrix (GLCM) feature extraction and probabilistic neural network (PNN) classifier. The brain tumor is an abnormal growth of uncontrolled cancerous tissues in the brain. A brain tumor can be benign and malignant. The benign tumor has uniformity structures and contains non-active cancer cells. The malignant tumor has non-uniformity structures and contains active cancer cells that spread all over parts.

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Due to the tremendous advancement in image acquisition devices, the data is quite large (moving to big data), that makes it challenging and interesting for image analysis. This rapid growth in medical images and modalities requires extensive and tedious efforts by medical expert that is subjective, prone to human error and may have large variations across different expert. Alternative solution is using machine learning techniques to automate diagnosis process however, traditional machine learning methods are not sufficient to deal with complex problem. Happy marriage of high performance computing with machine learning promise the capacity to deal big medical image data for accurate and efficient diagnosis[2]. Deep learning will not only help to not only help to select and extract features but also construct new ones, furthermore, it does not only diagnose the disease but also measure predictive target and provides actionable prediction models to help physician efficiently.

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Machine Learning (ML) and Artificial Intelligence (AI) have progressed rapidly in recent years. Techniques of ML and AI have played important role in medical field like medical image processing, computer-aided diagnosis, image interpretation, image fusion, image registration, image segmentation, image guided therapy, image retrieval and analysis Techniques of ML extract information from the images and represents information effectively and efficiently. The ML and AI facilitate and assist doctors that they can diagnose and predict accurate and faster the risk of diseases and prevent them in time. These techniques enhance the abilities of doctors and researchers to under-stand that how to analyze the generic variations which will lead to disease. These techniques composed of conventional algorithms without learning like Support Vector Machine (SVM), Neural Network (NN), KNN etc. and deep learning algorithms such as Convolutional Neural Network (CNN), Recurrent neural Network (RNN), Long Short term Memory (LSTM), Extreme Learning Machine (ELM), Generative Adversarial Networks (GANs) etc. Former algorithms are limited in processing the natural images in their raw form, time consuming, based on expert knowledge and requires a lot time for tuning the features. The later algorithms are fed with raw data, automatic features learner and fast. These algorithms try to learn multiple levels of abstraction, representation and information automatically from large set of images that exhibit the desired behavior of data.

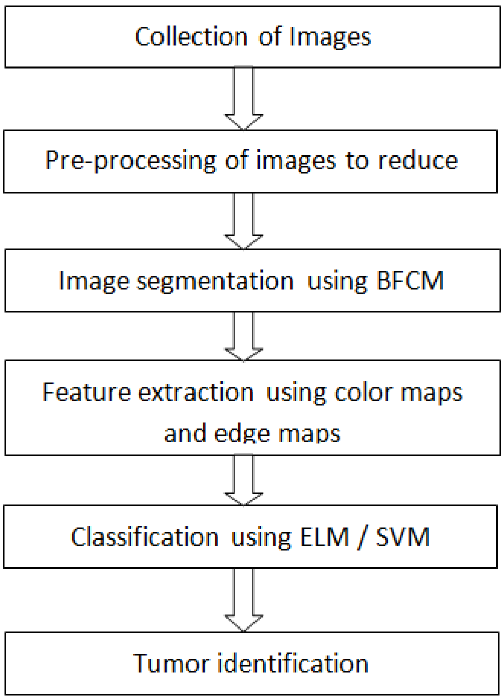

Fig: Block Diagram of Proposed Method

As shown in the block diagram, detecting brain tumor using image processing technique involves four stages. Image preprocessing, segmentation, feature extraction and classification.

First it collect the image and the primary task of preprocessing is to improve the quality of Magnetic Resonance (MR) images, removing the irrelevant noise and undesired parts in the background and preserving its edges. In segmentation, the pre-processed brain MR images are converted into binary images. Feature extraction is process of collecting higher level information of an image such as color, shape, texture and contrast. And the classification process, the classifier is used to classify the normal trained image samples and the input image sample.

II. METHODOLOGY

Is a multi-paradigm numerical computing environment and language developed by Math Works. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python.

Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.

- The input images first given to a segmentation block where it is segmented and resumes of interest are evaluated.
- Feature extraction is done on segmented images in that way to get texture and color the segmented result.
- After feature extraction database is created and evaluated with the help of SVM or ELN technique.
- After evaluation result are compaired with in terms of accuracy and delay of system.

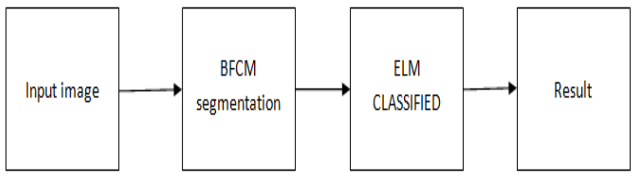

Figure: Block Diagram

III. PERFORMANCE PARAMETER

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Image processing and analysis methods

Different Image processing methods and techniques are used to make the image clearer and enhanced so that accurate diagnosis can be performed. Different ways are adopted for this purpose but the targeted area of this study is limited to the major steps like filtration, image segmentation, features extraction selection and classification. These major techniques will lead to accurate diagnosis of tumor from brain MR images.

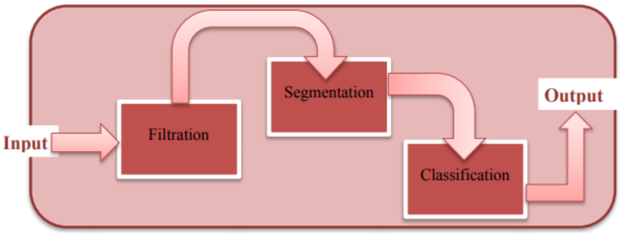

Figure: Image processing and analysis method

Image filtration and de-noising is the first preprocessing step dealing with image processing. In image, de-noising is processed using certain restoration techniques to remove induced noise which may creep in the image during acquisition, transmission or compression process. This process increases and enhances the quality of image to get the better and accurate results.

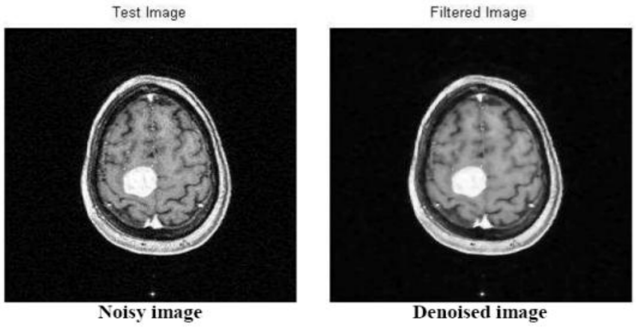

Figure: Example of noisy image and de-noisy image

Feature extraction using color maps and edge maps

Given pre-processed images, this phase refers to various quantitative measurements used for decision making regarding the class of pixels (normal or abnormal). More precisely, for each pixel, we should compute a feature vector. Thus, the output of this phase will be unlabeled data set.

Tumor regions for each image in the training set will be selected and validated by the radiologist. In order to select these regions, active contour models [15] [16] will be used to dene anatomical contours of tumor regions, due to their ability to approximate accurately the random shapes of boundaries. Once the labeled training set containing normal and tumourous pixels is constructed, SVM can be trained, so that the output of this step will be the classification model allowing the discrimination between normal and tumor pixels.

Classification using ELM

Performed by one of the robust supervised learning algorithm, support vector machine. Once it is trained, the new image's feature vector can be fed to the model to classify it into either benign or malignant.

Image classification is a process of extracting the classes of information from the multiband raster images. Basically, three types of classification: pixel-wised, sub pixel-wised and object-based. Main focus of this study is pixel-wised image classification [14] which can further be separated by three groups: supervised classification (user guideline), unsupervised classification (calculated by software) both are most common approaches but object based image analysis is very uncommon and latest technique as mentioned than remaining two and in this technique, high resolution images are used as an input.

IV. SIMULATION AND RESULTS

Used 60 total images half of which are benign and the rest are malignant, applied 100 iterations to assign randomly half of the data points for training and holdout half for testing. Since, this assignment iterates hundred times, there's very high possibility for each to be used as both training and testing data point at least once. This in turn highly increases the accuracy of the model by avoiding over fitting. MRI Image data have several characteristics, such as scans orientations, number of slices, inter-slice distance, slices, dimensions, and kind of modalities (T1, T2, FLAIR). These parameters vary differently from one patient to another depending on tumor requirements. In this thesis, I used only Flair weighted axial slices during the training and testing phase. Flair MRI images are the best imaging modality to visualize and detect the tumor region as it appears different from other normal tissues. My image database is relative to 60 axial images of 12 patients the first seven of which are suffering from low grade glioma (benign tumor) and the rest five are patients with GBM (malignant tumor). In general, the types and number of images collected.

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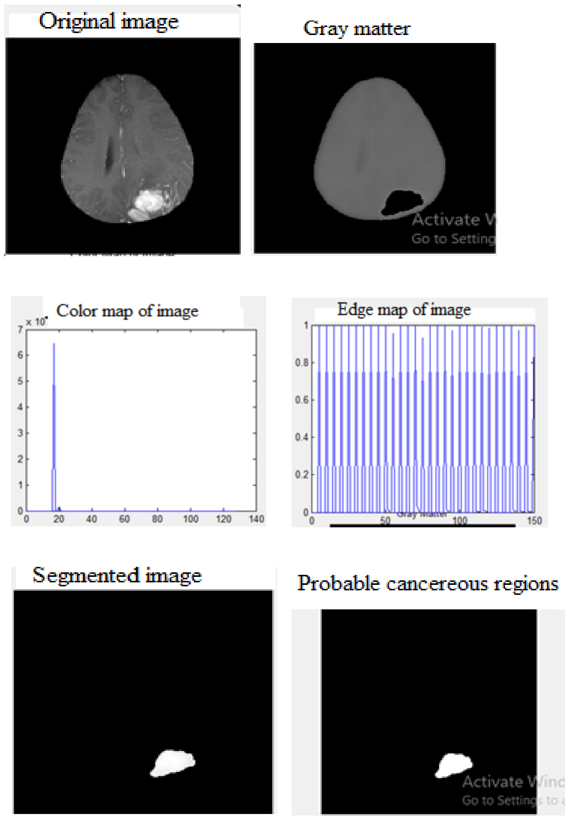

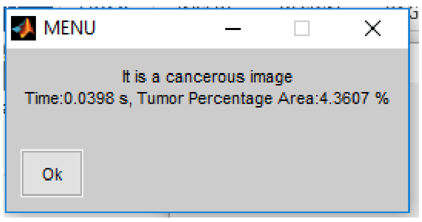

V. OBSERVATION

From the result, we observed the following parameters

Number of images in DB	Number of images tested	Number of correct outputs SVM	Number of correct outputs ELM	Accuracy SVM	Accuracy ELM
10	10	9	9	90.00	90.00
20	20	17	18	85.00	90.00
30	30	25	26	83.33	86.67
50	50	41	45	82.00	90.00
75	75	62	70	82.67	93.33
100	100	76	89	76.00	89.00
125	125	108	116	86.40	92.80
150	150	127	131	84.67	87.33

VI. CONCLUSION

During the recent few years, deep learning has gained a central position toward the automation of our daily life and delivered considerable improvements as compared to traditional machine learning algorithms. Deep learning based applications will take over human and most of the daily activities with be performed by autonomous machine. However, penetration of deep learning in healthcare especially in medical image is quite slow as compare to the other real world problems. We highlighted the barriers that are reducing the growth in health sector. We highlighted state of the art applications of deep learning in medical image analysis. Though, the list is by no means complete however it provides an indication of the long-ranging deep learning impact in the medical imaging industry today.

The proposed method is an innovative method to detect and classify tumors in MRIs of the brain. ELM method performs well in segmentation as well as in classification than SVM.

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